

Large Scale Networking (LSN)

NITRD Agencies: NSF, OSD and DoD Service research organizations, NIH, DARPA, DOE/SC, NSA, NASA, AHRQ, NIST, DOE/NNSA, NOAA

Other Participants: USGS

LSN members coordinate Federal agency networking R&D in leading-edge networking technologies, services, and enhanced performance, including programs in new architectures, optical network testbeds, security, infrastructure, middleware, end-to-end performance measurement, and advanced network components; grid and collaboration networking tools and services; and engineering, management, and use of large-scale networks for scientific and applications R&D. The results of this coordinated R&D, once deployed, can assure that the next generation of the Internet will be scalable, trustworthy, and flexible.

President's 2007 Request

Strategic Priorities Underlying This Request

Large-scale data transfers: Enable near-real-time petabyte and above data transfers, by 2008, to support science cooperation and modeling in high-energy physics, bioinformatics, weather, astrophysics, and other areas, overcoming scalability limitations of current technology and the Internet Protocol (IP)

New architectures: Develop future Internet architectures that are flexible, trustworthy (secure, reliable, ensuring privacy), and able to support pervasive computing using wireless access and optical light paths, networked sensors, and innovative applications (e.g., applications on the fly and large-scale information dissemination)

End-to-end performance measurement: Develop visibility into the interior of networks to enable optimization of application performance over networks; implement standard measurement boxes, standard protocols, and cooperation across domain boundaries to allow end-to-end application performance tuning

Highlights of Request

Optical network testbeds (ONTs): NSF's CHEETAH and DRAGON networks, DOE/SC's UltraScience Net; coordinate with OMNInet, OptiPuter, NationalLambda Rail, and regional ONTs; develop GMPLS, QoS, agile circuit-switching, and interdomain control plane protocols, tools, services, and management (e.g., resource reservation, security) – DARPA, DOE/SC, NASA, NSF

Innovative network architectures: Global Environment for Network Investigations (GENI) support of R&D for a large-scale testbed for new scalable, flexible, usable new Internet architectures – NSF with DARPA, DOE/SC, NASA, NIST

Network security research: Provide more trustworthy networking – DARPA, DHS, DOE/SC, NSF, NIST, OSD

End-to-end agile networking, QoS, GMPLS: Develop robust capability and technologies to provide on-demand networking and assured bandwidth for advanced networking applications – DARPA, DOE/SC, NASA, NSF, other agencies

Wireless and sensor networking: Advance capabilities for highly distributed, ubiquitous networking – DARPA, NIST, NSF, other agencies

Large-scale data flows: Infiniband and single-stream flows over WANs – DOE/SC, NASA, NSF, DoD (NRL)

High-speed transport protocols: Develop protocols to move massive amounts of data – DOE/SC, NSF

IPv6 and cyber security implementation: Rollout of IPv6 into research networks in response to OMB requirements – All

End-to-end network performance monitoring and measurement: Identify intrusions and bottlenecks and isolate faults – DARPA, DOE/SC, NSA, NSF, OSD (HPCMPO)

Network backup: Provide alternative capacity during network outages, stress, or national crises – DOE/SC, NASA, OSD (HPCMPO)

International coordination: Leverage investments in federated security regimes and optical networking transparency – DOE/SC, NSF

Planning and Coordination Supporting Request

Co-funding: NSF networking research projects receive support from DARPA, DOE/SC, NSA, DHS

Workshops: Annual government/private sector ONT workshops to provide input into coordinated Federal activities for R&D and promote technology transfer; NSF GENI workshops to coordinate research on new

architectures, experimental infrastructure, and control plane technology; academia/industry/government workshop to identify networking R&D needs – Multiple agencies

Coordination by LSN Teams:

- **Joint Engineering Team (JET):** DOE/SC, NASA, NIH, NIST, NOAA, NSA, NSF, OSD (HPCMPO), USGS, with participation by academic organizations (CAIDA, CENIC, Internet2, ISI, MAX, NLNR, StarLight), national labs (ANL), supercomputing centers (ARSC, MCNC, PSC), universities (FIU, IU, UIC, UMD, UNC, UW), and vendors – ONTs; engineering research networks (JETnets); security best practices; applications testbeds (IPv6, IPv6 multicast, performance measurement); metrics and monitoring: interdomain, end-to-end, internal network visibility; tool sharing and data exchange; 9,000-byte MTU recommendation; international coordination; transit and services cooperation
- **Middleware and Grid Infrastructure Coordination (MAGIC) Team:** DOE/SC, NIH, NIST, NOAA, NSF, with participation by academic organizations (EDUCAUSE, Internet2, ISI, UCAR), national labs (ANL, LANL, LBL, PNL), universities (UIUC, UMD, UNC, UWisc), and vendors – Middleware and grid tools and services; applications; coordinated certificate authorities for security and privacy; collaboration infrastructure; standards development; international coordination (e.g., federated certificate authorities under Americas Policy Management Authority)
- **Networking Research Team (NRT):** DARPA, DOE/SC, NASA, NIST, NSA, NSF – Basic research (technology and systems); prototyping and testing of optical networks (dynamic provisioning, GMPLS-based control plane); applications; wireless, nomadic (ad hoc, mobile) networking; education and training

Information exchange: Multiagency LSN participation in review panels, informational meetings, principal investigator (PI) meetings; tactical coordination among program managers with common interests; coordination of JET meetings with DOE ESSC and Internet2 Joint Techs Meetings; GMPLS forum coordinating development of interdomain signaling in agile optical networks

Additional 2006 and 2007 Activities by Agency

NSF: Support university-based fundamental networking research in trust, pervasive computing; innovative research in architectures, algorithms, protocols, sensor network programming, hardware/software, and privacy/security; programmable wireless networks; network measurement; CAREER awards for networking research; infrastructure research (create, test, harden next-generation systems); middleware development and dissemination

OSD (HPCMPO): IP end-to-end performance measurement, network monitoring tools, IPv6 pilots and IPv6 multicast, network security (IPsec, VPN portals, attack detection tools, filters, encryption), automated management, disaster recovery planning, research network broadband access to Hawaii and Alaska

NIH: R&D on data and computational grids in support of biomedical research, including Biomedical Informatics Research Network (BIRN) and cancer Biomedical Informatics Grid (caBIG); focus on QoS, security, medical data privacy, network management, and collaboratory infrastructure technologies

DARPA: Network-aware control plane; connectionless sensor networks minimizing energy consumption; Situation-Aware Protocols In Edge Network Technologies (SAPIENT); optical data router for >100 Tbps bandwidth

DOE/SC: Middleware and network research (security, data management, standards-based protocols, advanced reservation and scheduling); Open Science Grid (operational infrastructure for large-scale applications); UltraScience Net (research and engineering prototype); connectivity (ESnet, MANs, collaboration services, trust federations and authentication services)

NSA: Internet measurement; wireless networks (ad hoc sensor networks, wireless capacity enhancement, wireless in noisy environments, WLAN QoS, WLAN/WAN simulation); GMPLS evolution for optical networks

NASA: Real-time interactive and grid applications; Columbia supercomputer networking support; network security, data distribution, and real-time visualization

NIST: Internet infrastructure protection, quantum information networks, health-care networks, criminal-justice information systems, wireless ad hoc networks, public safety communications; standards and guidelines for management and assistance; and process control systems protocols and security

NOAA: Advanced networking infrastructure, including lambda-based networking, IPv6, distributed Web servers; computer and network security; applications (collaboration, grid computing (e.g., for storm-scale simulations), wireless, remote operation)